FOREST Management BULLETIN

MANAGING FOR NATURAL REGENERATION

By Hamlin L. Williston and William E. Balmer*
Task Force Leaders

SEPTEMBER 1974

Published by S. E. Area, State and Private Forestry — USDA Forest Service — 1720 Peachtree Rd., N.W. — Atlanta, Georgia 30309

THE VIABLE ALTERNATIVE

The need for growing southern pines as fast as possible to meet predicted wood demands has focused much attention on clearcutting and replanting. This method offers the use of genetically improved seedlings, controlled spacing and density, and minimum time lag between rotations—all adding up to maximum per-acre production of wood products.

Yet more than half of the South's pine forest lands will not be clearcut and replanted. For one thing it's expensive. The average cost exceeds $40 per acre. On some lands it costs $100 and more, depending upon the need for site preparation and type of planting method required. The majority of small landowners find this too rich for their pocketbooks. Many large owners don't favor the system because of high cost at the very beginning of the rotation. For many owners, clearcutting and replanting is impossible due to shortage of manpower and equipment. Others avoid this practice because it conflicts with their objectives.

For such reasons, thousands of forest landowners of the South are deciding "to dance with who brung 'em". Their forests were reforested naturally to begin with, and they'll stick with that method of regeneration. This is the viable alternative.

But to be a viable alternative, natural regeneration can't be regarded as letting nature take its course. Forests must be managed for effective natural regeneration. Else the time lag between harvest and new crop could be economic suicide. Or excessive tree density could necessitate expensive precommercial thinning, wiping out savings in planting cost. Or a scarcity of reproduction could underutilize the planting site, robbing the landowner of potential returns from his land. In other words, effective natural reforestation is not free.

With that agreed upon, this Bulletin will deal with natural reforestation techniques for the landowner who has a stand of seed-bearing pine trees ready for harvest.

NOTE: These guidelines on natural regeneration were prepared by an interdisciplinary task force appointed by the Southeastern Area, State and Private Forestry of the U. S. Forest Service. The task force made extensive use of forestry research findings, as well as observing operations in the field. Members of the task force, in addition to the leaders, were: Ed. Burns, chief of forest management for the Louisiana Forestry Commission; Kenneth Jeffries of the North Carolina Forest Service; David Van Lear of Clemson University; Richard Williams of Georgia-Pacific Corporation; and Patrick Barry, entomologist; Robert Jackson, fire specialist; Ed. Kerr, writer; and Keith Utz, forest finance specialist, of the U. S. Forest Service.

* Authors are forest management specialists with Southeastern Area, State and Private Forestry, U. S. Forest Service.

PROS AND CONS

First, it must be understood that natural regeneration, compared to clearcutting and planting, has advantages and disadvantages. Advantages are:

- Lower establishment cost
- Less labor and heavy equipment required
- No problem with geographical origin of seed
- Chance of tip moth damage reduced
- Better early root system developed by natural seedlings
- Selection management more practical with this system
- Less immediate visual impact
- Less soil movement

Disadvantages are:

- Less control over spacing and initial stocking
- Longer rotations needed
- Risk of seed tree loss
- Lower yields as a rule
- No use of genetically improved stock
- Loss of year or two of growth because of failure to regenerate promptly
- Need for precommercial thinning in many stands to obtain good growth
- Limited application in pulpwood rotations because of low seed production from dense, young stands
- Irregular stands not well suited for mechanical harvesting
- Less access for fire equipment

WHAT RETURNS CAN BE EXPECTED

The following investment analysis, using unpublished plot data from loblolly pine studies in North Carolina and Virginia, shows that precommercial thinning and hardwood control increased both yields and financial returns at the end of a 20-year period: The table below shows the economic returns from these stands with two treatments and a control.

Treatment	Present Net Worth at 6%	Net Annual Equivalent at 6%
	---------- Per Acre----------	
Precommercial thinning plus hardwood control	$41.01	$3.58
Hardwood Control Only	31.14	2.71
No Treatment	13.78	1.20

Note: Treatments should increase returns even more over a longer period.

The analysis is based on the following assumptions:

- pulpwood price of $8.00 per cord
- precommercial thinning and hardwood control at age 3 at a cost of $12.00 per acre for each treatment
- stand established from seed trees within first growing season after harvest cut

This is a seed tree? *Unfortunately, it is intended to be. Seed tree method of regeneration can upgrade the stand if the best trees are left for seeding the area.*

- seed trees removed during the second growing season
- one-year growth loss from reducing fully stocked stand to seed trees valued at cost of $16.00 per acre.

If it is anticipated that establishment of the new stand will require more than two growing seasons, the growth loss may well exceed cost of artificial regeneration. This highlights the importance of timing the cut to coincide with a good seed crop.

TYPE OF MANAGEMENT

Fortunately, the landowner who decides upon natural regeneration has a variety of all-aged and even-aged systems of management open to him.

If after removing most of the poor quality trees in his stand he still has a good stocking of vigorously growing pine over much of the acreage, the landowner may want to manage an all-aged forest. This can be done by periodically harvesting groups of trees to create openings for regeneration.

If the landowner wants to use even-aged management, at least five methods are available:

1. Seed tree is the most frequently used method. Number of seed trees will depend upon size, species, cone-bearing characteristics, and site conditions.

2. Clearcut in strips. If the landowner wants to make periodic cuts while managing in even-aged units, he can clearcut in strips, say 200 feet wide. Strips should be perpendicular to direction of prevailing winds.

3. Shelterwood entails leaving many seed trees (about 30 to 60 square feet of basal area depending upon species).

4. Seed-in-place involves clearcutting the stand after the peak of seed fall but prior to the start of germination. It is best applied during a four-to five-month winter logging period. As with seedlings-in-place, the technique can be used only when an ample crop of seed is available.

5. Seedlings-in-place involves clearcutting the stand during the summer following a good seed year. Indications are that the landowner will lose some height growth compared to the seed-in-place method. This is because seedlings spend most of the first growing season in the shade of the overwood. However, the loss in height growth likely will be offset by the additional growth of the overstory. Too, with seedlings-in-place, the landowner can be more certain of actual number of trees after germination.

The job isn't over. *A good seed fall doesn't mean the work is done in natural regeneration. This tract must be thinned precommercially to attain good growth.*

FACTS ABOUT SEEDING

Seeding characteristics of the various species vary with the area, weather conditions and other factors, so the landowner and his forester must estimate the best time to catch a seedfall. Just a few pointers are in order:

1. Loblolly, Virginia and shortleaf are the most dependable seeders. Trees with adequate growing space usually can be depended upon to produce an adequate seed crop at least every two or three years.

2. Longleaf pine is not a prolific seed producer and its large seeds are appetizing to a host of predators, including squirrels, birds, and mice. A carefully selected stand, 30 or more years of age, with a density of about 30 square feet of basal area per acre will produce useable crops at about three-year intervals on average sites.

Don't forget fire protection. *In naturally regenerated areas, a system of fire lanes and/or access roads can be developed by disking or other methods.*

3. Slash pine seeds are generally produced on three-year cycles, although some are borne almost every year.

4. About 50,000 seeds per acre is the minimum needed to restock a burned seedbed.

5. When selecting seed trees, remember that pine pollen is not carried in effective quantities farther than 300 feet.

6. The range of longleaf seed flight is only one and one-half times the height of the tree. Effective seed dispersal of loblolly and shortleaf is 200 feet.

7. Releasing seed trees from competition stimulates a substantial increase in seed production within the third year.

Seed trees of all four species should be at least 10 inches in diameter and preferably 12 to 16 inches. Remember, seed trees are the key to the next crop. They should be dominant trees of good quality that give indication of previous fruitfulness. The numbers cited in Table 1 not only will produce enough seed but will provide enough volume to attract a logger when the time comes to remove the seed trees. They also provide some insurance against loss to lightning, wind damage and other threats.

TABLE 1
MINIMUM RECOMMENDED NUMBER OF SEED TREES

DBH	Shortleaf	Loblolly	Slash	Longleaf*	Virginia
9					6
10	20	12	12	55	5
12	14	9	9	38	4
14	12	6	6	28	4
16+	12	4	4	21	4

*Shelterwood — 30 square feet basal area

SITE PREPARATION

Some form of site disturbance is generally desirable for natural regeneration. This is particularly true with longleaf and slash, which require a seedbed of exposed mineral soil to achieve a satisfactory stocking of seedlings. Note the difference in seedlings established through various litter depths in southeast Arkansas following a good loblolly seed crop:

Litter Depth in inches	Number of Seedlings Per Acre
0.0-0.5	26,000
0.6-1.0	14,000
1.1-1.5	10,000
1.6-2.0	4,000
2.1-2.5	4,000
2.6-3.0	500
3.1-3.5	1,000

What type or combinations of site preparation are needed will depend upon the expected seed crop and the species of pine. The important point is that most natural regeneration in the South has resulted in too much stocking, not too little.

Logging

In some cases soil disturbance during the logging operation is sufficient to provide a good seedbed. For example, if seedfall of loblolly is expected to exceed 80,000 seeds per acre, additional seedbed preparation may be unnecessary.

No release treatment. *Natural pine regeneration is there but is badly in need of release from overtopping hardwoods.*

Spraying

If hardwood competition is moderate, aerial or ground spraying with herbicides can be done anytime within one to three years after logging. Assuming only one release is needed, the cost should run about $15 to $20 per acre. Spraying can hold back sprout development long enough for regeneration to become established over a two or three year period, without severe competition. If it becomes necessary, spraying can be repeated three or four years after establishment to keep the hardwood competition in check.*

Results of chemical release. *This stand was chemically treated to rid the area of overtopping hardwoods.*

Prescribed Burning

Two or more annual burns prior to harvest will provide good seedbed conditions and a high degree of hardwood control. A single burn following harvest can do the same, but there is always danger of burning up the seed trees where logging slash is unusually heavy. The after-harvest burn should be accomplished no more than two months before seedfall.

If strip clearcutting is used, the cleared area should be burned after the fuel is cured and before the next seedfall. Too long a delay will permit a heavy grass rough to build up. These strips provide the forest-edge conditions desired by wildlife and are narrow enough to be utilized to the maximum.

Prescribed burning is not only a good tool for site preparation, but is also one of the best tools for improving wildlife habitat. It sets back woody plants, making new sprout growth available for deer. It also stimulates seed germination and growth of valuable herbaceous plants and makes their seed more available to birds by removing the litter accumulation.

*Pesticides should never be applied if they endanger humans, livestock, crops, beneficial insects, or fish and wildlife. They should not be applied when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues. Since the registration of pesticides is under constant review by state and federal authorities, a responsible state and federal agency should be consulted as to the present status of any pesticide before its use.

Seed tree regeneration. *This area was cut and burned about two years before, leaving seed trees to regenerate the new crop of pines. Although not visible, pine reproduction is already on the ground.*

Chopping, Disking and Dozing

Use of heavy machinery should be limited to the more difficult sites – those with extensive hardwood competition, dearth of seed trees, or extremely dry – or with hard-to-generate species. Else, too dense stocking will result. In dozing, a shearing blade is preferable; unless skillfully used, the straight blade or root rake removes too much topsoil, reducing site quality. Situations are rare in which chopping, combined with spraying and/or burning, would not suffice.

PRECOMMERCIAL THINNING

If despite all precaution stocking is more than 1500 seedlings per acre, the stand should be thinned precommercially at the age of 3-5 years. This is the age when thinning is most economical and insect-caused losses can be avoided. Precommercial thinning is needed particularly in dense stands of shortleaf and slash, because these species do not assert dominance as quickly as loblolly and longleaf pine. It also is needed on poor sites where expression of early dominance is generally a problem. Full details on techniques of precommercial thinning are found in the Forest Management Bulletin, "The Need for Precommercial Thinning". Copies are available from Southeastern Area, State and Private Forestry, 1720 Peachtree Road, N.W., Atlanta, Georgia 30309.

FOREST FIRE PRECAUTIONS

All too often, land managers tend to regenerate stands with too little thought given to stand protection needs, particularly from wildfire. Except for longleaf, young stands are particularly susceptible to wildfire the first six to ten years following establishment.

In naturally regenerated areas, a system of fire lanes and/or access roads can be developed by chopping, disking, bushhogging, or other methods, and will greatly enhance future protection efforts. During these early years of a young stand, rough buildups can become quite severe in many cases, and a break-up of the fuel continuity is highly desirable from the protection standpoint.

INSECT AND DISEASE PRECAUTIONS

Insect and disease problems are not as common or devastating in naturally regenerated stands as in planted stands; however, a number of insect and disease pests are likely to be encountered by the land manager.

The reproduction weevils – pales and root collar, for example – can cause a problem in young natural regeneration adjacent to or near any thinning operations, or near piles of green lumber.

The pine tip moth is another insect to be aware of on all species of pine. It attacks the terminals of the main stem and branches. This insect is not usually a problem in natural regeneration where the stand has some type of overstory or brush intermingled with the reproduction.

Diseases such as fusiform rust, brown spot, and littleleaf have little respect for stand origin or type in most cases. Fusiform rust, for example, can present a problem to slash and loblolly in natural stands as well as plantations in high-rust hazard areas in the South. Brown spot will present a problem to natural, direct seeded and planted longleaf pine in the grass stage in many southern localities. Properly planned and timed prescribed burning represents the most practical control for this disease problem.

Appreciation is extended to the following field units assisting the task force: Virginia Division of Forestry; Southeastern Forest Experiment Station, Charleston, S.C., Crown Zellerbach Corporation, Bogalusa, La.; Georgia-Pacific Corporation, Fordyce, Ark.; Potlatch Forests, Inc., Warren, Arkansas; Southern Forest Experiment Station, Fayetteville, Ark. and Brewton, Ala.; Weyerhaeuser Company, Hot Springs, Ark.; and Ouachita and Mississippi National Forests.

NATURAL REGENERATION GUIDE*

Situation	Species	What to Do
Well-stocked stand, owner wants to manage a forest in even-aged units while making periodic cuts.	Loblolly shortleaf and slash.	Starting at leeward side clear-cut strips approximately 200 feet wide. Burn strips after the fuel is cured and before the next seedfall.
Well-stocked stand to be managed in even-aged units. Periodic cuts not required.	Loblolly, shortleaf and slash.	Use seed tree method. For loblolly, seed-in-place and seedling-in-place also can be used.
Well-stocked stand, owner wants to manage forest as all-aged units while making periodic cuts.	Loblolly & shortleaf.	Harvest groups of trees periodically to create openings for regeneration. Prescribe burn for site preparation. Spray hardwood brush as needed with herbicide to free young pine from competition.
Mature, slow-growing or sparse pine stands.	Loblolly, shortleaf and slash.	Cut back to seed trees. Burn prior to seedfall in a good year. Remove seed trees when the young pines are 1-3 years old.
Understocked or mature stand.	Longleaf	Cut back to a shelterwood of 30 square feet of basal area per acre. Remove when seedlings are established.
Stands of seed bearing size.	Virginia**	Use even-aged management only. Clearcut in alternate or progressive strips using seed trees for final strip.
Scattered sawlog pine. Heavy understory of hardwood brush.	All pine species.	Chop and burn when debris is dry, or spray with herbicides in May or June and burn in late August or early September.

*Intended only as a quick checklist. In many cases, more than one alternative is open to the landowner and decisions must be made on an individual basis.

**Virginia pine should be considered only for short rotations because of its limbiness and susceptibility to heart rot. Thinning should be avoided because of wind and ice damage. If large products are desired and site is good, consider conversion to other species.

Suggested Reading

Balmer, W. E. and Williston, H. L. 1973. The need for precommercial thinning. S.E. Area, S&PF, U.S. Forest Service Forest Management Bulletin, 6 pp.

Bramlett, D. L. 1965. Shortleaf pine seed production in the Piedmont. U. S. Forest Service Res. Note SE-38, 4 pp.

Campbell, T. E. 1967. Loblolly-shortleaf pine seedfall in Louisiana. J. Forestry 65:894, 895.

Cooper, R. W. and Perry, J. H. Jr., 1956. Slash pine seedling habits. So. Lbrmn. 193 (Dec. 15):198-199.

Croker, T. C. Jr. Natural regeneration systems for longleaf pine. Forest Farmer 28(13): 6-7. 16-18.

Fenton, R..H. and Bond, A. R., 1964. The silvics and silviculture of Virginia Pine in southern Maryland. NE-27. 36 pp.

Grano, C. X. 1949. Is litter a barrier to the initial establishment of shortleaf and loblolly pine reproduction. J. Forestry 47:544-548.

Hall, L. K., 1973. Managing deer habitat in loblolly-shortleaf pine forests. J. For. 71:752-757.

———— 1971. Conditioning loessial soils for natural loblolly and shortleaf pine seeding. U. S. For. Service Res. Note SO-116.

Lotti, Thomas, 1961. The case for natural regeneration. Louisiana State Univ. 10th Annual Forestry Symposium Proc. 16-25.

Mann, William F. and Enghardt, H. G., 1973. Development of slash pine regeneration beneath overstories. SO-170. 5 pp.

Mattoon, W. R. 1940. Slash pine. USDA Farmers' Bul. 1256.

Mobley, et al, 1973. A guide for prescribed fire in southern forests. 40 pp.

Speake, Dan W. 1966. Effects of controlled burning on bobwhite quail populations and habitat of an experimental area in the Alabama Piedmont. Proc. 20 th Ann. Conf. Southeastern Assn. Game and Fish Comm. p. 19-32.

Stephenson, G. K. 1963. Ten years of shortleaf pine seed crops in Texas. J. Forestry 61:270-272.

Trousdell, K. B. and Wenger, K. F. 1963. Some factors of climate and soil affecting establishment of loblolly pine stands. Forest Sci. 9(2): 130-136.

————, K. B. and Langdon, O. G. 1967. Disking and prescribed burning for loblolly pine regeneration. J. Forest. 65:548-551.

Wakeley, P. C. 1947. The 1947 cone crop and forest fires. So. For. Notes 51.

Wenger, K. F. 1957. Annual variation in the seed crops of loblolly pine. J. Forestry 55:567-569.

Yocom, H. A. 1968. Shortleaf pine seed dispersal. J. Forestry 66:422.